INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior

National Park Service

All or some of the information you provide may become available to the public.

OMB # (1024-0236)
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Form No. (10-226)

Reporting Year: 2008	**Park:** Shenandoah NP	**Select the type of permit this report addresses:** Scientific Study

Name of principal investigator or responsible official: Damon Ely	**Office Phone:** 540-231-6679
Mailing address: 3845 Roanoke Rd. Christiansburg, VA 24073 USA	**Office FAX** **Office Email** elyda1@vt.edu

Additional investigators or key field assistants (first name, last name, office phone, office email)

Name: Herbert Maurice Valett **Phone:** 540-231-2065 **Email:** mvalett@vt.edu

Project Title (maximum 300 characters):

Increased acidity and nitrogen availability in Appalachian streams: interactive effects on nitrogen spiraling

Park-assigned Study or Activity #:	**Park-assigned Permit #:**	**Permit Start Date:**	**Permit Expiration Date:**
SHEN-00335	SHEN-2007-SCI-0004	Mar 26, 2007	Feb 11, 2008

Scientific Study Starting Date:	**Estimated Scientific Study Ending Date:**
Mar 26, 2007	Feb 11, 2008

For either a Scientific Study or a Science Education Activity, the status is:

Continuing

For a Scientific Study that is completed, please check each of the following that applies:

__ A final report has been provided to the park or will be provided to the park within the next two years

__ Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park

__ All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed

Activity Type:

Research

Subject/Discipline:

Water Resources

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

The purpose of the study is to understand how acid deposition may impair algal and microbial-driven in-stream processes of energy flow and nitrogen cycling, impairments which become apparent at the ecosystem scale with chronic stream acidification. The effects of stream acidity on community structure are most often reported with little emphasis on functional impairment. The proposed research will be the first to investigate the role of pH and associated factors on nitrogen processing, which is a valuable stream ecosystem service that may be impaired due to decades of anthropogenically-induced acidic precipitation. Long-term watershed acidification research has taken place at Shenandoah National Park and this proposal seeks to build on the existing knowledge base by increasing our understanding of whole-system effects on stream function within the park. Please see the attached proposal for a comprehensive explanation of the overall purpose and specific objectives of the study.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

Laboratory experiments were performed on leaf biofilms collected from five streams spanning a pH gradient (5.0 to 7.0); these experiments addressed the influence of chronic stream pH on the respiratory and nutrient-uptake potential of leaf biofilm-associated

fungi, which are the primary sink for water column nitrogen (N) following autumnal leaf fall. Details on experimental design are as described in our previous report. We found that both biomass-specific respiration (qCO2) and biomass-specific N uptake increased with increasing acidity and these two variables showed a strong positive relationship. The rise in qCO2 was expected as this is a common index of stress and we predicted that organisms from more acidic streams would exhibit higher levels of stress. Unexpectedly, N uptake also increased with stress; we expected a decrease because N uptake is usually associated with optimal conditions favoring growth. Therefore, we hypothesized that the observed increase in N uptake with increasing stress was due to a heightened level of exoenzyme activity (N-rich proteins) in efforts to acquire the additional carbon resources dictated by the increased qCO2. To address this hypothesis, exoenzyme activities of leaf biofilms were conducted by introducing biofilms to fluorescent-labeled carbon and nitrogen substrates and monitoring fluorescence over time. The enzymes assayed were glucosidase, xylosidase, and proline aminopeptidase; rates of enzyme activity were standardized by the quantity of fungal biomass present. We found greater rates of exoenzyme activity by biofilms from more acidic streams for each enzyme assessed. Thus, it appears that stream acidification is an environmental stress that reduces biomass of primary nutrient uptake compartments and accelerates the biomass-specific uptake of inorganic nitrogen, which may immediately be transformed to an organic form and transferred outside the organism. Implications for whole-stream qCO2 and N uptake depend on the balance between microbial abundance and biomass-specific rates within each stream.

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

No

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):	**Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):**
$0	$1000

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year: